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Time spent on milking mares and their ethological indicators

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Abstract. Dairy horse breeding in Ukraine is not a traditional branch of animal husbandry, although its products most closely correspond to the physiology of human digestion and are especially indispensable in children's nutrition, since the chemical composition of mares' milk is close to that of women. To obtain mare's milk, it is necessary to take into account the technological features of keeping, feeding animals and obtaining products specific to a particular farm, which should be reflected in technological maps. The most time-consuming process in the production of milk of all types of animals is the milking process, therefore the purpose of this work was to develop standards of time consumption for the further development of technological maps in dairy breeding and to study the productive and ethological indicators of dairy mares taking into account the serial number of milking. The research was carried out at the Kumys farm, a breeding breeder for the breeding of the Novoaleksandrivsky weight-carrying breed of horses of the Dibriv Horse Stud No. 62 branch of the State Enterprise "Studying of Ukraine" using video surveillance, time measurement, biometrics, and mathematical calculations. It was established that the

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time spent on milking is directly dependent on the productivity of mares and increases with the serial number of milking. Ethological studies have shown that mares willingly go to milking and in the same order and sequence to the left and right milking machines. Supplementation with oat grains takes place during milking at the milking plant, the time spent there is not enough to consume the daily requirement due to concentrated feeds, and the time spent by mares in the pre-milking area exceeds the normative indicators. Standards for time spent on the milking process have been developed, taking into account the ethological features of mares and suggestions for its improvement through the organization of standardized individual feeding and the frequency of milking, which will increase the gross production of marketable milk. The practical value of the work consists in determining the time spent on milking mares, depending on their productivity, which will later be used as normative indicators during the development of technological maps

Keywords: duration of milking; timing; performance of mares; behavior; heavy breed; koumiss

INTRODUCTION

The Kumys farm of the Dibriv stud farm in Poltava region was organized in 1984, which is connected with the transfer of some horses of the Novooleksandriv horse breed from the Novooleksandriv stud farm of the Donetsk region. During this time, both the technology of keeping and the genetic potential of animals changed somewhat. Thus, according to D. Volkov & S. Lyutykh (2014), only in the period 2000-2012, the number of lines in the breed decreased from seven to three, and significant changes took place in the breed, both in terms of numbers and basic breeding characteristics: origin, type of body structure, measurements, work capacity, fertility, quality of offspring. Therefore, the issue of improving technological maps for the production of mares' milk, one of the main sources of costs for which is the milking process, becomes urgent.

In his works, O. Havryk (2021) notes that for the development of animal husbandry, it is necessary not only to improve the production process in general, but also the correct organization of management accounting is necessary, which will allow to reduce the cost of production and ensure the efficiency of the industry with the help of cost accounting and the calculation of certain standards.

Work Í. Barreto *et al*. (2019) indicate that the main source of milk and milk products is cattle, which account for 82% of the world's total milk, with the rest mainly coming from buffaloes, goats and sheep, and less than 1% of milk coming from other animals such as like camels, horses, donkeys, which can be defined as "secondary dairy species".

In Ukraine, dairy horse breeding is represented by single koumiss farms in Poltava, Luhansk and Kyiv regions, which combine the production of mares' milk and the production of koumiss with meat or breeding specialization of the industry.

The expediency of using mare's milk is indicated by the work of S. Aitbaeva & B. Bimbetov (2016), who note that children aged 1-3 years should be introduced to the diet of saumal (freshly milked mare's milk), starting with 20-40 ml, depending on age, and after getting used to the enzymatic function, increase the single dose to 50-70 ml for an average daily portion of 250-350 ml, and for children of preschool age (3-7 years), the single dose is 60-80 ml. Based on these recommendations, simple calculations can be made, from which it follows that with a norm of only 250 ml of milk per day, the annual need per person will be 91.25 l, and with a mare's milk productivity within 2500 l of milk per lactation – one mare can provide the annual needs of only 27 people. According to P. Verbytskyi *et al*. (2008) the volume of production of milk and koumiss in Ukraine does not satisfy the needs of the population and increases its scarcity, so it is advisable to set up small koumiss farms on the basis of industrial farms. Taking into account the medical and health-promoting and biological features of koumiss, koumiss farms should be organized in close proximity to the main consumer – sanatorium-treatment facilities.

It is possible to increase the volume of production of mare's milk both by increasing the herd and increasing its milk productivity, and by improving and adapting existing technologies to various natural and climatic zones, which will make it possible to realize the genetic potential of animals to the maximum. According to I. Suprun (2020), for the revival of horse breeding, its stabilization and further effective development, rational coordination of production, substantiation and development of organizational provisions, standards of management of the horse breeding industry are necessary.

Scientific developments and the development of technological maps, which will provide for all technological operations taking into account time, material, energy resources, biological, economic and ethological characteristics of horses, deserve special attention. Authors J. Auclair-Ronzaud *et al*. (2022) point out that studies in dairy farming have mainly focused on qualitative milk parameters, and information on quantitative

characteristics is incomplete, partly due to a lack of consensus on the method of milk yield measurement. Undoubtedly, the most time-consuming process in the production of milk of all types of animals is the process of milking, and time consumption is mainly presented for dairy cows, therefore the purpose of this work was to determine the duration of milking, the total stay of mares in milking machines and the pre-milking area, the amount of concentrated concentrated feeds, features of their reaction behavior and productive indicators, depending on the serial number of milking.

LITERATURE REVIEW

The increased interest in horse milk is due to the unique properties of this type of milk and products made from it, as indicated by the work of D. Baibokonov *et al.* (2021). According to G. Czyżak-Runowska *et al.* (2021) mare's milk has valuable nutritional and medicinal properties and is recommended in the diet of people with weakened immunity, in particular, the elderly, and is considered useful for the prevention of atherosclerosis.

The work of A. Musaev *et al.* (2021) indicates that in terms of chemical composition and nutritional properties, mare's milk is close to human milk, does not cause allergies and can be a substitute for the most common cow's milk, and in terms of the composition of essential amino acids and the biological value of proteins, it significantly exceeds it. Research by L. Figliola *et al.* (2021) indicates that food allergy in young children is mainly represented by a hyperergic (immunological) reaction to one or more cow's milk proteins. Its prevalence in children of the first year is not exactly known and is estimated to be from 2 to 6%, and it is also noted that in almost half of children, the clinical manifestations of allergy to cow's milk proteins (CBM) decrease or disappear at the end of the first year, and up to 80% – during the first 3 years of life. Based on this, we can conclude that it is necessary to find sources, substitutes for cow's milk, one of which can be the milk of mares.

The expediency of including fermented milk products from mare's milk in the diet of children 1-11 years old is evidenced by the results of research by A. Yakunin *et al.* (2017), and F. Fantuz *et al.* (2016) note that the only significant fermented mare's milk product available on the market is koumiss, which is widely used primarily for its medicinal and nutritional value. Thus, the research results of Q. Li *et al.* (2022) showed that koumiss regulates the condition of the gastrointestinal tract, improves the assimilation of nutrients, improves the body's lactose intolerance, increases immunity, prevents scurvy and atherosclerosis, and helps in the treatment of tuberculosis. Researchers I. Barreto *et al.* (2019) point out aspects that deserve attention and that support recommendations for the use of mare's milk as a human food, namely its similarity to human milk, its high palatability, the therapeutic properties of koumiss (which derive from its richness in probiotics), the balance between casein and whey proteins, the presence of bioactive compounds and the nutritional value of the lipid fraction. In fact, the results obtained in the studies analyzed above have proven the functionality of this milk as a food product and suggest that its inclusion in the human diet may have several beneficial health effects.

In the work of E. Jastrzębska *et al.* (2017) indicated that mare's milk contains a wide range of valuable nutrients with health-promoting properties, and the world market offers an increasing number of food and cosmetic products made from it.

In the conditions of Ukraine, the industrial production of mares' milk is carried out on farms with a small number of herds (10-30 milking mares), namely on breeding breeders from the breeding of the Novoaleksandrivska weight-carrying breed of horses, since they make good use of rough, green and pasture fodder, and also differ fairly high milk yield per 100 kg of live weight. Such an insignificant number of farm livestock is explained by the small number of reproductive composition of mares in the Novoaleksandrivskaya breed.

Thus, the results of research by I. Tkachova (2021) indicate that only 114 mares were involved in breeding work with this breed. According to S. Forest (2018) there are only about 30 producers of mare's milk in Germany alone and most are located throughout Europe, mainly in the Netherlands, Belgium and France, and notes that horses will not produce much milk because they are not genetically programmed produce milk like a cow, and according to J. Auclair-Ronzauda *et al.*, (2022) the factors affecting milk yield are mare live weight, fatness at calving and age. Authors S. Nahornyi *et al.* (2020) explain that such a small composition of enterprises is due to the general reduction of the horse population in Ukraine. Thus, the total number of horses in all categories of farms decreased by 56% from 2005 to 2019, and according to the State statistics service of Ukraine (2021), for the period from 2019 to 2021, the number of horses in farms of all categories decreased by another 17.2% and on January 1, 2021, it amounted to 202,000 heads. At the same time, the main number of horses is concentrated in households, and only 6% of their total number are kept in agricultural enterprises. The number of breeding horses has also decreased, the share of which for the period of 2019 is only 1.3% of the total number of livestock. Especially significant reductions in the breeding stock occurred in the period from 2010. Thus, the decrease of the Ukrainian riding breed is – 78.7%, the Orlovska Rysista – 62.8%, the Hutsul – by almost 53%. The situation is similar with the Novoaleksandrivska weight-carrying breed, which,

according to the FAO (Food and Agriculture Organization) classification, approaches the border of "rare" and "endangered".

Also, I. Suprun (2020) notes that in the conditions of a long crisis over the past 14 years, breeding horse breeding in Ukraine has undergone a significant decrease in the number of livestock, a narrowing of the breed structure and a change in the form of ownership. As of the beginning of 2019, according to the State Register of Breeding Subjects in Livestock Breeding, there are 38 stud farms and 20 breeding breeders in Ukraine. The largest population of breeding horses is concentrated in the eastern regions of Ukraine: Luhansk, Kharkiv, Dnipropetrovsk, Kirovohrad, Zaporizhia. It has been established that the leaders in terms of numbers among factory horse breeds are the Ukrainian riding horse, the Oryol trotting horse, and the thoroughbred riding horse.

According to V. Pabat & I. Honcharenko (2019), the small number of horses in farms of all forms of ownership is a temporary phenomenon, and as the state economy grows, the importance of the industry in the national economy will increase, which will lead to the need for specialists in the zooengineering profile.

MATERIALS AND METHODS

The time spent on the milking process and the reaction of the mares' behavior were determined at the end of the lactation period (133-193 days of lactation) during two accounting days – October 20 and 21, 2022 at the Kumys farm, a breeder for the breeding of the Novoaleksandriv weight-carrying breed of horses of the branch "Dibrivsky stud farm No. 62" SE "Konyarstvo Ukrainy" of Myrhorod district, Poltava region. The research was carried out at the initiative of the authors with the permission of the enterprise administration, during which the ethological features of the technological group of dairy mares (n=10) were studied through individual time-lapse observations, and the productivity indicators were based on the results of the control milk yield for each of the three, provided by the technology in the milking farm . During the research, all rules for keeping and handling animals during the research were observed according to Law of Ukraine No. 27 "On Protection of Animals from Cruel Treatment" (2006). No animal during the study was harmed or suffered as a result of harsh treatment.

All indicators were studied based on the results of the work of the same operator. The amount of milk produced was determined from each mare and measured using electronic scales with an accuracy of 1 g. The results of the research were processed by biometric methods on a PC in the Microsoft Office Excel environment using software. Daily milk productivity was calculated according to the formula of I.A. Saigin:

$$V_C = \frac{V_F \cdot 24}{t}, \quad (1)$$

where V_C – the mare's daily milk yield; V_F – the amount of milk expressed during the considered time, l; t – the time during which the calculated milk was expressed; 24 – the number of hours in a day (Karnozhytskyi *et al.*, 2012).

Dairy mares were evaluated by four measurements: height at the withers, oblique length of the body, breast girth, and instep girth using a measuring stick and tape. The height at the withers was measured with a measuring stick from the highest point of the withers vertically to the floor, the oblique length of the body was measured with a measuring stick from the front protrusion of the shoulder-scapular joint to the rear protrusion of the buttock, the chest girth was determined using a tape that passed through the withers, touching the back corners of the shoulder blades, and the girth of the wrist – with a tape in its lower part of the upper third. The ratio of the interrelated diameters of the animal's body was expressed as a percentage, calculated by body structure indices according to the formulas:

$$\text{Format index} = \frac{\text{Oblique length of the body} \cdot 100\%}{\text{Height at the withers}}, \quad (2)$$

$$\text{Chest girth index} = \frac{\text{Girth index} \cdot 100\%}{\text{Height at the withers}}, \quad (3)$$

$$\text{Ossification index} = \frac{\text{Wrist girth} \cdot 100\%}{\text{Height at the withers}}. \quad (4)$$

Before conducting the observations, the specific conditions of mares' milk production, the way they are kept, feeding rations, the condition and features of the equipment used, the duties of the operators were specified, and the regimes of work and rest were analyzed.

The research involved the preliminary determination before observation of the fixation points, that is, the moments of the end of one element and the beginning of another. Measurements were made with an accuracy of 1 second using a digital stopwatch. In order to more accurately determine the time spent, video recording of all technological operations of the milking process was carried out in parallel, after which a comparative analysis of the obtained results was carried out. Of the total operating time, the time for obtaining milk during the milking process was studied, namely, taking into account the time from connecting the milking cups to removing them from the udder, since preparatory and final operations during milking of mares take a small amount of time, compared to similar operations in dairy farming, as well as the sequence of their entry, the total time spent by mares at the milking station and one head in the milking machine.

All procedures were carried out in accordance with ethical considerations regarding the involvement of

animals according to the recommendations of ARRIVE (n.d.). The authors of this study assure compliance with all ethical standards in research involving animals.

RESULTS AND DISCUSSION

The technology of the Kumys farm, a breeding breeder for the breeding of the Novoaleksandrivsky weight-carrying breed of horses of the Dibriv Horse Breeding No. 62 branch of the SE "Konyarstvo Ukrainy" provides for seasonal production, since insemination takes place within 2 months (February-March) and, accordingly, calving takes place in March-April. Milking of mares begins when the foals are one month old, after which they are trained to mechanized milking using the DDU-2M milking unit and DDA-2M two-stroke milking machines, the design feature of which is the automatic adjustment of work modes, depending on the intensity of milk production. Before the start of milk production, the device works with a rest cycle, that is, for one pulsation of the device, the triad "suction – compression – rest" is carried out in a gentle mode, and at the beginning of the phase of intensive milk release, the device automatically switches to the mode of continuous suction, outputting the main amount in 20-25 seconds When the speed of milk delivery decreases, the device starts working again in the mode with a rest cycle. Milking with a two-mode DDA-2M device does not cause mastitis in mares even if it is used on the teats for too long. Therefore, the operator can freely work with two devices at the same time. The optimal mode of operation of the device is ensured at a vacuum of 0.42-0.45 kg/cm^2. The throughput capacity of the DDU-2M installation when milking with two machines in 2 machines is 50-60 mares per hour. The duration of lactation of mares ranges from 6-7 months, after which the foals are completely weaned from them. Milk is sold in the form of the final product of its processing – koumiss.

In the summer, dairy mares are kept on walking and feeding grounds, after three milkings – on a pasture with foals, and at night until 6 a.m. – also on grounds, that is, mares and foals are together for about 17.5 hours a day and separately , respectively – 6.5 hours. In the winter, mares are kept on walking and feeding grounds (during the day), and at night in the capital premises – in sections of 10 heads at the rate of 6.5-7 m^2 per head (Marchenko *et al.*, 2018). Three milkings are used on the farm, the first of which takes place at 8 in the morning, the next at 10 and 12, respectively, i.e. the time interval until the first milking, and between the following is two hours, after which foals are brought to the mares, which are deliberately kept until 6 in the morning, i.e. mares are without foals for 6.5 hours. The milking plant consists of two milking machines (Fig. 1), which are a welded construction of metal pipes and are located at an angle of 20-26°C relative to each other, between which the workplace of the machine milking operator is located.

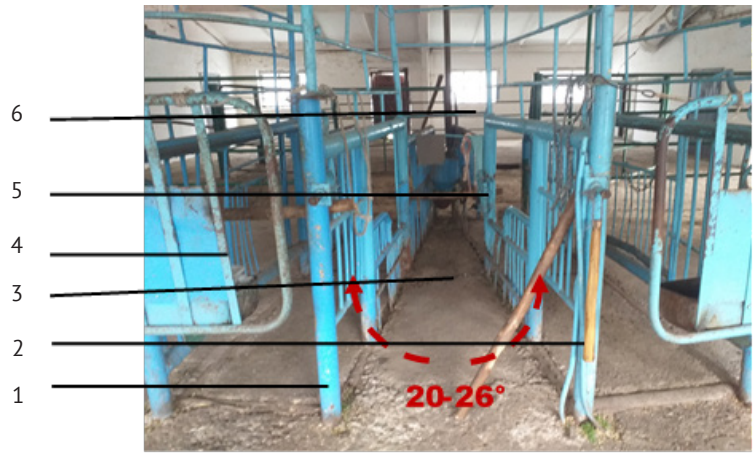

***Figure** 1. General view of the DDU-2M milking unit for milking mares*
***Notes**: 1 – left machine; 2 – right machine; 3 – workplace of machine milking operator; 4 – door with a hinged feeder; 5 – guiding split; 6 – storage area*
***Source**: developed by the authors*

The mares enter the milking machines from the pre-milking platform, the time spent on which should not exceed 10 minutes, along the guide split 80-90 cm wide. Although this design allows two mares to be milked simultaneously with two milking machines, milking is done by one milking machine and one operator, because the company where the research was conducted has a small number of dairy mares. Ethological studies have shown that mares willingly go to milking and almost in the same order and sequence to the left and right milking machines (Table 1).

Table 1. *Sequence and machine in which mares were milked*

No.	Serial milking number and mare's nickname						The highest occurrence	
	I		II		III			
	left	right	left	right	left	right	left	right
1	Turbina	Raffaella	Turbina	Frau	Turbina	Raffaella	Turbina	Raffaella
2	Frau	Torba	Referee	Raffaella	Frau	Feofania	Frau	?
3	Troya	Fura	Torba	Fantasia	Torba	Fura	Torba	Fura
4	Biosphere	Fantasia	Troya	Biosphere	Troya	Fantasia	Troya	Fantasia
5	Referee	Feofania	Fura	Feofania	Referee	Biosphere	Referee	Feofania

Notes*: the color assigned to the mare is highlighted in color*
Source*: developed by the authors*

The first two mares enter the free stalls at the same time, in the future - alternately after the release of the previous one, and the last two are also released at the same time. During milking, mares are fed with oat grains, the consumption time of 1 kg of which is 5.140±0.243 minutes. The average age of the technological group of dairy mares is 8 years and ranges from 4 to 14. In the experiments of G. Czyżak-Runowska *et al.* (2021) also noted significant age ranges of the technological group of dairy mares, which ranged from 5 to 14 years. The oldest mares are Rafaella (born in 2008) and Turbina (born in 2011) and who, perhaps, occupy the highest step in the hierarchy and are the first to be milked, or have some life experience with feeding concentrated feed in milking machines. Also, these mares can be the largest in size and cause physical competition with other mares of the group, but the data in Table 2 indicate that they are not physically different from the general herd, from which we can conclude that the main factor behind competition is age of animals It should be noted that even with a slight violation of the milking sequence, the mares still follow the machine that they are used to milking from the beginning of lactation, and thus the orderliness and consistency of the milking machine for a particular animal can be Raffaella judged by the most frequent occurrence and sequence of milking. In this case, the right loom remains unpainted, the second position in the milking sequence, and it would be logical to enter a mare named Biosphere there, but she confidently occupies the penultimate step in the sequence, sharing it with the mares Fantasia, Troya and Feofania. Such a "fight" for the competition during the second milking in the right milking machine can be explained by the inconsistency between the mares and Frau, who was the first in the right milking machine during the second milking, chasing away Raphaella, which is again explained by the competition for the first milking and the opportunity to consume concentrated feeds

First-born mares deserve special attention: Fura and Feofania (Table 2), which, at first glance, may occupy a lower hierarchical rank and to a lesser extent can compete with more mature and physically formed individuals. Thus, the mare Fura was always milked third in the right stall, and Feofania was the last and also in the right stall. According to J. Auclair-Ronzauda *et al.* (2022), younger mares produced less milk than older mares, which indicated incomplete development of mammary gland tissues in primiparous mares.

Table 2. *Characteristics of the technological group of dairy mares*

The name of the mare	Age, years	Milk yield for three milking sessions, kg	Measurements of mares, sm				Physiological indexes		
			Height at stifle	Oblique length	Chest circumference	Heel circumference	Format	Chest circumference	Bone density
Turbina	11	2,365	163	162	209	23.5	99.3	128.2	14.4
Rafaella	14	2,295	164	161	201	24	98.2	122.6	14.6
Torba	9	2,606	154	160	207	23.5	103.9	134.4	15.3
Frau	5	1,318	163	165	204	24	101.2	125.1	14.7
Fura (f)	5	1,658	165	163	198	23.5	98.8	120.0	14.2
Troya	9	1,882	164	167	208	23.5	101.8	126.8	14.3

Table 2, Continued

The name of the mare	Age, years	Milk yield for three milking sessions, kg	Measurements of mares, sm				Physiological indexes		
			Height at stifle	Oblique length	Chest circumference	Heel circumference	Format	Chest circumference	Bone density
Fantasia	11	1.18	159	167	208	24	105.03	130.8	15.1
Biosphere	7	2,389	159	162	204	23	101.9	128.3	14.5
Feofania (f)	4	2,308	155	156	197	23	100.6	127.1	14.8
Referee	5	2,211	158	161	200	23	101.9	126.6	14.6
Average	8.000 ±1.054	2,021 ±0.154	160.4 ±1.249	162.4 ±1.056	203.6 ±1.392	23.5 ±0.129	101.263 ±0.683	126.990 ±1.267	14.650 ±0.109

Notes: *nickname (f) – mare with first lactation*
Source: *developed by the authors*

As can be seen from the data in Table 2, the technological group of dairy mares is quite different in age, and in terms of measurements and body structure indices, they meet the standards of the breed, with a somewhat small format index, which is significantly affected by the oblique length of the body. No significant difference in milk productivity between firstborns and adult mares, as well as the influence of animal age, was found, which can be explained by the small group of studied animals, among which there were only two mares with the first lactation. In the work of J. Auclair-Ronzauda *et al.* (2022) noted that the maximum potential milk productivity of mares is reached at the age of 7 years. This study emphasized the effect of age, but did not record an increase in milk yield up to 7 years of age and a decrease thereafter. It was established that the time spent on milking is directly dependent on the productivity of mares (Table 3).

Table 3. *Time spent on technological operations, depending on the serial number of milking*

Indexes	Serial number of milking			Average	Overall for 3 milking
	I	II	III		
Time spent on milking, min	8.55	9.16	10.28	9.33	27.99
Total time of stay of mares in milking, sec	51.300 ±4.578	55.000 ±3.521	61.700 ±3.022	56.000 ±3.044	168
Total time of stay of mares in milking, min	14.45	16.24	17.10	15.93	47.79
Total time of stay of mares in milking, min	2.959 ±0.236	2.593 ±0.243	2.806 ±0.314	2.786 ±0.106	8.358
Time of stay of 1 head in the milking machine, excluding the 2nd and penultimate, min	2.618 ±0.068	2.323 ±0.182	2.413 ±0.215	2.451 ±0.087	7.354
Time of stay of 1 head in the milking machine, excluding the 2nd and penultimate, min	4.325 ±0.205	3.675 ±0.525	4.380 ±0.180	4.127 ±0.226	12.38
Duration of stay of the last mare on the pre-milking platform, min	11.52	11.49	14.09	12.367	37.10
Duration of stay of the last mare on the pre-milking platform, min	1.85	1.34	1.18	1.457	1.38

Source: *developed by the authors*

Thus, for the productivity of mares 0.463 kg of milk during the first milking 0.685 and 0.874 kg during the second and third, the time spent on milking one head is 51.3 sec and 55.0 and 61.7, respectively, but the total time spent on obtaining 1 kg of milk are reduced from 1.85 minutes during the first milking to 1.64 and 1.18 during the second and third, that is, inversely proportional to the average milk yield from one mare during the control milking and the daily milk productivity in general. The lowest indicators of milk productivity of mares were obtained during the first milking, with a further increase during the second and third (Fig. 2).

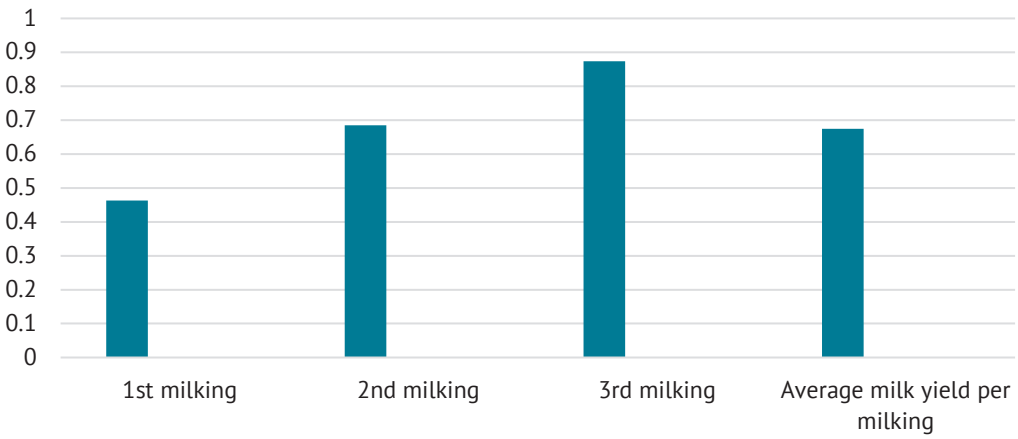

Figure 2. *Milk productivity of mares*

Note: *milk yield per head, kg*
Source: *developed by the authors*

Such insignificant indicators of milk productivity of mares, on average for one milking 0.674±0.119 kg/goal, are explained by the fact that the accounting was carried out at the end of the lactation period and amounted to an average of 150.5 days of lactation, and according to A. D'Alessandro & G. Martemucci (2012) peak lactation in mares occurs on day 48. According to N. Miraglia *et al.* (2020), milk productivity depends on many factors, including rearing, housing and feeding systems, milking strategy and type (hand or machine), individual milk yield, stage of lactation, animal body size and condition, and the amount of milk collected per milking varies within 500-2000 ml for the main ones and 200-900 ml for the first-borns.

A similar regularity of the increase in milking milking sequence number was also obtained in the scientific and economic experiments of T.A. Yusyuk (2017), which is explained by the fact that mares retain milk to feed foals and give it in larger quantities during the second and third, which is characteristic of equids and depends on the biological structure of their mammary gland, and J. Auclair-Ronzaud *et al.* (2022) explain that the increase in the level of oxytocin provoked by the first milking can have consequences for the subsequent increase in milk yield and that the mare's response to stimulation during milking is different and individual.

It is significant that the time spent by the last mare on the pre-milking platform, which should not exceed 10 minutes, also depends on the milk productivity of the mares and their time spent in the milking machines, which is 12.367 minutes on average, i.e. 23.7% higher than the normative indicators. Also, the amount of concentrated fodder consumed (oat grain) depends on the time the mares stay in the milking machines and is an average of 2.8 minutes, during which one head can consume only 0.54 kg of oats, and for three milkings – 1.62 kg. The feeding rations of dairy mares provide for the feeding of 6 fodder units per day, or 6 kg in the form of oat grains, the difference of which (4.38 kg) they must receive on the walking and feeding grounds, which equalizes the normalized individual feeding of each head separately.

In this case, the second and penultimate mare according to the serial milking number is in the most advantageous position, since two heads are simultaneously milked, later they alternate one by one and two are released at the same time, and their time in the milking machine significantly increases to 4.12 minutes, compared to others – 2.45. Therefore, in order to solve this problem, it is necessary to organize individual feeding of mares on walking and feeding grounds, which requires significant capital investments in production, or to increase the duration of the stay of mares in milking machines due to the addition of additional ones, or to reduce a technological group of dairy mares, which will also reduce the time they stay at the pre-milking area.

It should also be noted that the average daily milk productivity of mares is 7.5 kg of milk per day and only 2.02 kg (for three milkings) is used for the production of kumis, i.e. 27%, and 5.48 is spent on feeding the foal. T. Bat-Oyun *et al.* (2018) note that in the steppes of Central Asia, mares are milked 4-5 times a day, while on more intensive dairy farms located in Europe, they are milked more often, depending on consumer demand, up to eight times a day at two-hour intervals. Milking is carried out at least 2 hours after weaning the foal from the mare. This distinctive feature of dairy farming gave rise to the neologism "milking session", that is, the time from the separation of the foal to the end of each milking. Thus, in an 8-hour working day, one operator can cover only three milkings per working shift, and with more milkings, an operator is needed for the next shift.

On the one hand, this phenomenon increases the costs of manual labor, and on the other hand, it contributes to the employment of the population of rural areas. According to N. Miraglia *et al.* (2020), horse breeding is one of the most promising activities in rural development, which is considered a key strategy for restructuring the agricultural sector through diversification and innovation. The variety of horse breeds involved not only in their use for work and tourism, but also in activities related to the production of food and non-food products and is a strong argument for the preservation of endangered breeds and populations. Many breeds occupy specific niches and contribute to biodiversity through their own genetic characteristics derived from adaptive mechanisms developed over centuries of evolution in specific local environments. The revival of interest in mare's milk and its derivatives today is supported by newly created dairy horse enterprises that have developed in France, Italy, Mongolia, China, Kazakhstan, Kyrgyzstan, Greece, Germany and many other countries.

CONCLUSIONS

To calculate technological maps, it is necessary to take into account the milk productivity of mares and use as standards the time spent on milking one head of 51.3 seconds for the productivity of 0.463 kg of milk, 55 s for the productivity of 0.685 kg and 61.7 s for the productivity of 0.874 kg, respectively. Ethological studies have shown that mares willingly go to the milking plant, since it is there that they are fed with concentrated fodder, but the stay time even for three milkings is not enough to consume their daily normOlder mares are the first to be milked, and all others follow a certain order and sequence, following the machines where they are used to being milked. The duration of stay of the last mares in line at the pre-milking platform exceeds the normative 10 minutes, which can be solved by reducing the technological group, or by building additional milking machines and thus increasing the time of feeding horses with concentrated fodder. The reaction of animal behavior can serve as an indicator of technological parameters and must be taken into account when developing new and improving existing technologies for the production of livestock products. During the three-time milking of mares, there is a direct linear relationship between its serial number, milk yield and time consumption – an increase in milk yield and time consumption from the first to subsequent milkings. Due to the small technological group of dairy mares, the research did not reveal any relationship between milk productivity, age and serial number of lactation.

For the purpose of standardized feeding, it is necessary to organize individual feeding of dairy mares with concentrated fodder, depending on their productivity. To increase the level of profitability of kumys production, transfer the milking of mares from three to five times, which will increase the production of marketable milk. In order to calculate technological maps, standards of time consumption not only for the milking process, but also standards for care, feeding, accustoming young mares to milking, grazing, etc., are needed, which is what further scientific research is focused on.

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CONFLICT OF INTEREST

None.

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Анотація. Молочне конярство в Україні не є традиційною галуззю тваринництва, хоча його продукція найбільше відповідає фізіології травлення людини і особливо незамінна у дитячому харчуванні, оскільки молоко кобил за хімічним складом наближається до жіночого. Для отримання молока кобил необхідно враховувати технологічні особливості утримання, годівлі тварин та одержання продукції, притаманних конкретному господарству, що повинно відображатись в технологічних картах. Найбільш трудоємним процесом у виробництві молока усіх видів тварин є процес доїння, тому метою цієї роботи була розробка нормативів витрат часу для подальшого розроблення технологічних карт у молочному конярстві та вивчення продуктивних і етологічних показників дійних кобил з урахуванням порядкового номера доїння. Дослідження проводили на кумисній фермі, племінному репродукторі з розведення Новоолександрівської ваговозної породи коней філії «Дібрівський кінний завод № 62» Державного підприємства «Конярство України» з використанням методів відеоспостереження, часового вимірювання, біометрії, а також математичних розрахунків. Встановлено, що витрати часу на доїння знаходяться в прямій залежності від продуктивності кобил і підвищуються з порядковим номером доїння. Етологічні дослідження показали, що кобили охоче ідуть на доїння і в однаковій черговості і послідовності на лівий та правий доїльні станки. Підгодівля зернами вівса відбувається під час доїння на доїльній установці, часу перебування на якій не достатньо для споживання норми добової потреби за рахунок концентрованих кормів, а час перебування кобил на переддоїльному майданчику перевищує нормативні показники. Розроблено нормативи витрат часу на процес доїння, з урахуванням етологічних особливостей кобил і пропозиції з його удосконалення за рахунок організації нормованої індивідуальної годівлі та кратності доїння, що збільшить валове виробництво товарного молока. Практична цінність роботи полягає у визначенні витрат часу на доїння кобил, залежно від їх продуктивності, які в подальшому будуть використані як нормативні показники під час розробки технологічних карт

Ключові слова: тривалість доїння; хронометраж; продуктивність кобил; поведінка; ваговозна порода; кумис